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# AGRICULTURAL NEWS LETTER

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This publication gives information on new developments of interest to agriculture on laboratory and field investigations of the du Pont Company and its subsidiary companies.

In addition to reporting results of the investigations of the Company and its subsidiaries, published reports and direct contributions of investigators of agricultural experiment stations and other institutions are given dealing with the Company's products and other subjects of agricultural interest.



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THE USE OF PLANT EXTRACTIVES OR DRIED GROUND PLANTS  
IN INSECT CONTROL OFFERS A BROAD FIELD FOR RESEARCH

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EDITOR'S NOTE:- This interesting and informative contribution presents facts of value to the chemical investigator in the field of insecticides, the entomologist, the botanist and others interested in the development of new and better means to combat insect pests. The list of literature on the subject, which Dr. Dietz supplies, is also valuable.

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The use of plant extractives or of pulverized whole plants or parts of plants as insecticides is one that has always excited interest, even from early times. Plant extractives in the form of simple decoctions prepared by the medicine men were probably first used by primitive people as a means of freeing their persons from undesirable insect inhabitants.

Published data that have any semblance to scientific insect pest control do not date back further than the early 18th century. The oldest record published in modern languages on the use of a plant extractive is one that appeared in LA THEORIE de JARDINAGE, which appeared in 1711, in which the following instructions for making a pesticide occur: "Cantharides (blister beetles) are flies (beetles) which attach themselves to the branches near the upper parts of trees. They may be destroyed by pouring or throwing on the tops of the trees, by means of a small pump, water in which has been boiled some rue." By "rue" is probably meant the herb Ruta graveolens, a European herb having a very strong, disagreeable odor and a very bitter taste. It will be noted that such use of a compound of this nature probably places it in the class of foliage protectants or repellents.

However, plant extractives were evidently subject to criticism in those early days because J. A. E. Goeze, in one of the early textbooks of entomology entitled DIE GESCHICHTE EINIGER SCHADLICHEN INSEKTEN, published in Leipzig in 1788, remarks that plant lice may be killed "with water of slaked lime or of strong soap, soot, sage, hyssop, wormwood, and other bitter or strong-smelling herbs . . . Tobacco and wormwood leave small particles on the treated portions. Other materials are often without value. Tansy, hellebore, rue, leek, bitter gourd and long pepper have the disadvantages just mentioned." This shows that the use of plant extractives as insecticides is not new, and that there was controversy as to their efficiency even at this early period.

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The literature relating to the fish poison plants, namely tropical members of the pea family, dates back to 1747, but the use of the active ingredients of these plants as insecticides does not date back more than three decades.

#### Investigation in United States Began in 1880

Active investigation of plant extractives as insecticides in the United States began with the establishment of economic entomology here in 1880, shortly after the introduction of the San Jose scale. At that time, the cotton leaf worm, which is now very easily controlled through the use of arsenicals, was the chief menace to cotton in the southern United States. A wide range of plant extractives was tested against this pest, none of which proved very effective.

The active investigation of the fish poison plants dates back to 1919 when McIndoo, Sievers and Abbott of the U. S. Department of Agriculture first reported on the efficiency of simple extractives in the control of a considerable number of pests. In 1924, McIndoo and Sievers published on their investigations of 232 preparations from 54 species of plants tested against a total number of 28 species of insects. Their conclusions were that of the 260 species of plants catalogued as being of possible insecticidal value, 94 were found by the writers and others to be of little or no value, and 109 other species recorded by other writers as used for insecticides were not supported by any experimental evidence of efficiency. Of the 260 species of plants catalogued, only about five per cent furnished material for efficient insecticides, and only half of these may be regarded as satisfactorily efficient. Among the extractives that were satisfactorily efficient insecticides, McIndoo and Sievers included three species of Chrysanthemum, namely cinerariaefolium, coccineum and marshallii, all of which species serve as a source of pyrethrum powder or pyrethrum extractives; two species of Derris or Deguelia (elliptica and uliginosa), both of which have subsequently proved sources of our present ground derris; and finally a Peruvian plant known to them only as "cube," which has finally proved to be Lonchocarpus nicou, a South American fish poison plant closely related to Derris or Deguelia. This significant statement is also made: "It does not seem at all probable that satisfactory insecticides can be obtained from the commoner weeds or flowers or from plants known to be only slightly poisonous to man or other animals. With regard to the poisonous plants, particularly the fish poisons found in the tropics or sub-tropics, the chances to obtain other efficient insecticidal material are very promising."

#### Pyrethrum and Fish Poison Plants

The history of pyrethrum as an insecticide parallels that of the fish poison plants and is of particular interest because of the present and extensive use of chemically and biologically standardized extractives of the active principles of pyrethrum flowers in household sprays. According to Lodeman in THE SPRAYING OF PLANTS (1896, pages 78-79), pyrethrum powder was used in the Caucasuses prior to 1828, at which date its commercial exploitation began. It was introduced into France in 1850 as a household insecticide. The growing of Pyrethrum, now Chrysanthemum cinerariaefolium, was undertaken in California in the late 1880's

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and by 1896 the powder (ground flower heads) had found a relatively wide usefulness as a household, greenhouse and truck crops insecticide under the name of "Buhach." This name distinguished the California product from that imported and designated as Persian or Dalmatian insect powder. Lodeman's suggestion (page 156) of a kerosene decoction of pyrethrum flowers may be regarded as the forerunner of our present fly or household sprays. Since the insecticidally active principles of pyrethrum occur only in the seeds of a few species, at most, of a genus of the daisy (aster or dandelion) family, it is rather remarkable that they should have been so early discovered and used by the natives of the wild and backward region to which these plants were restricted. However, the present general use of pyrethrum was dependent upon the activities of chemists in isolating and identifying the active principles, in improving the kerosene oils, and in determining the best solvents or extracting agents. All of these developments have taken place since 1920. The powerful and rapid paralytic action of the pyrethrins, the active principles of pyrethrum flowers on insects is difficult to duplicate. In practical insect control, recovery from such effects and the lack of general lethal action have restricted the widespread use of pyrethrum insecticides. Special pyrethrum compositions were tested in Japanese beetle control and found to be excellent temporary palliative measures, but of no value whatever where residual effects were highly desirable and necessary.

#### More than 600 Plants Investigated

To date, the possible insecticidal value of more than 600 different kinds of plants distributed among 110 plant families have been investigated. Out of this array of plants, only the following have any proved insecticidal efficiency: Anabasis aphylla, the source of anabasine; Delphinium consolida and D. staphisagria, the European field larkspurs, the source of tinctures of larkspur; Aeschrion (Picrasma) excelsa, the source of picrasmin, which is a moderately effective contact insecticide; the various fish poison plants, both of the Old World and New World tropics, all of which are members of the pea family belonging to the genera Derris (Deguelia), Lonchocarpus, Mundelea, and Tephrosia; the two or three species of Chrysanthemum which are the source of pyrethrum; and finally Nicotiniana, the source of nicotine.

Many plant extractives used in medicine which have pronounced physiological action on higher animals have shown little or no effective insecticidal action. Typical of such products are the toxics occurring in the members of the potato family (Solanaceae) other than Nicotiana; namely, atropine, hyocyamine, scopolamine, belladonna; or those occurring in digitalis, in the opium poppy or in deadly hemlock. Contrary to expectations, the so-called essential oils occurring in the members of the mint family possess little in the way of insecticidal properties.

On the other hand, wormseed oil derived from Chenopodium ambrosoides, a tropical weed closely related to our common lambsquarter, has been found useful in killing Japanese beetle grubs in balled nursery stock, whereas geraniol and eugenol, essential oils occurring in members of the geranium, citrus and other plant families, are now used as attractants in Japanese beetle traps.

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### Various Difficulties Encountered

Several difficulties are inherent in this problem. The first is that plant toxics do not necessarily occur in the same parts of all plants. Pyrethrum (pyrethrins) is found only in the seeds; the fish poisons, rotenone and other extractives, are found largely in the roots, whereas nicotine and anabasine (neo-nicotine) are found largely in the leaves and stems. Another difficulty is that the source of supply of effective materials may be distinctly limited because the same species of plant from different regions may vary widely in toxic agent content, depending on the environment in which it grew. Between two closely related species or even varieties, the variation may be even more pronounced; one may have a high toxic agent content; the other, none. Characteristic examples are found in derris, cube or timbo, tobacco, and various medicinal plants. Even when highly effective toxics are found, accumulated experience indicates that the possibility of synthesizing them cheaply enough to be commercial possibilities is not very promising. As examples, nicotine and anabasine (neo-nicotine) may be cited as compounds of comparatively simple structure, whereas rotenone is characteristic of the more complex type. None of these has been made in the laboratory at a cost approaching that of obtaining the natural product from the plants.

### Control of the Japanese Beetle

The use of plant extractives for Japanese beetle control has not been overlooked by the numerous State and Federal investigators. Geraniol and eugenol have already been referred to. These products were found in those plants that were heavily attacked by the insects. Likewise, the former is somewhat toxic to this insect (25 per cent kill) and its occurrence in comparatively high concentration in geraniums probably accounts for the mortality of beetles frequently observed around these plants and referred to in literature as early as 1929 (Safro et al.).

Metzger and Grant of the U. S. Bureau of Entomology Japanese Beetle Control Laboratory investigated the "Repellency to Japanese Beetle of Extracts made from Plants Immune to Attack." They tested 474 extracts made from 390 species of plants representing 326 genera and 128 plant families.

They conclude that "although the number of immune plants has by no means been exhausted, it is believed that a fairly comprehensive survey has been made. Only 56 extracts gave any indication of repellency. Thirteen of these were commercial extracts which probably repelled because of the conspicuous residue deposited on the foliage. Other white materials (such as lime and sulfur and casein\*) repelled equally well . . . The repellency of these materials was much less than that shown by powdered derris and pyrethrum applied in spray form at the rate of three pounds to 50 gallons of water. Ten extracts used at full strength on corn were repellent, but only three were of possible value. All three burned the husks severely. Further work could be conducted with extracts of plant species not yet tested, but, as the more important immune plants have been extracted, it is doubtful whether a continuation of this investigation would result in the discovery of a practical repellent for Japanese beetle."

\*Parenthesis by H.F.D.

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### An Alluring Problem

A search for insecticidally active plant extractives other than those now known is admittedly a fascinating problem. However, it is a problem on which a tremendous amount of effort can be spent without yielding any immediate, highly practical or profitable results. Apparently in the tropical and sub-tropical fish poison plants of the pea family, we already have insecticidally active products of broad usefulness, whose performance is difficult to match. In fact, of the plant families known to produce the largest number of physiologically active compounds to animals, the pea family leads the list in producing insecticidally active compounds. The buttercup family and the lily family are next in importance. Yet, it must not be overlooked that there is always the remote possibility of finding some unusually effective product where one might scarcely expect to find it. Of course, if such product is found, the problem of extracting it economically or determining its chemical compositions and synthesizing it commercially still remains. Such problems are in themselves of considerable magnitude.

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CHEMICAL REACTIONS IN FERTILIZER MIXTURES INVESTIGATED  
AND FINDINGS AS TO DECOMPOSITION OF DOLOMITE REPORTED

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EDITOR'S NOTE:- This summary contains facts of importance to agronomists, and the manufacturers and users of fertilizers. The original article, "Chemical Reactions in Fertilizer Mixtures -- Decomposition of Dolomite," was published in Industrial and Engineering Chemistry, Vol. 29, No. 10, page 1176, October, 1937.

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For many years it has been customary to use materials in fertilizer mixtures that contain magnesium as well as other minor plant food elements as incidental constituents, and the need for including magnesium in fertilizers to provide for deficiencies of this element in the soil was therefore not generally recognized until use was made of concentrated fertilizers prepared from relatively pure materials. It has now become a practice of many fertilizer mixers to include a quantity of a water-soluble magnesium compound, such as calcined kieserite, in the formulation of their mixtures. Dolomite differs from kieserite and other sources of water-soluble magnesia in that it is water insoluble. If it can be shown, however, that dolomite through reaction with other constituents of the fertilizer mixture can supply a considerable portion of the required soluble magnesia as well as a residual supply, it should logically replace the higher priced sources of magnesia, in part at least.

The reactions of dolomite with different components of fertilizer mixtures have been reported in several publications of the U. S. Department of Agriculture and the Tennessee Agricultural Experiment Station.

Studies in du Pont laboratories showed that two reactions occur during storage of ammoniated mixed fertilizers containing dolomite. The dolomite first reacts with the monoammonium phosphate, reducing water-soluble phosphoric acid but not causing loss of available phosphoric acid. If the temperature of the mixture is maintained above normal, however, tricalcium phosphate is formed as a result of secondary reactions. The loss of available phosphoric acid that occurs under these conditions varies with the time and temperature of storage, the degree of ammoniation, and the concentration of phosphoric acid.

The present investigation was undertaken to determine the rate and extent to which the reactions that dolomite undergoes in fertilizer mixtures affect the solubility of the magnesia.

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A study was also made of the comparative rate of dolomite decomposition in ammoniated and nonammoniated mixtures of a single- and double-strength grade.

The mixtures studied comprised two general groups--a nonammoniated and an ammoniated group. Urea was used in the first group as a source of nitrogen in place of the ammonia added to the second group. Each group was divided into two subgroups consisting of an ordinary mixture (3-9-5) and a high-analysis mixture (6-18-10).

The physiological acidity of the fertilizer materials in the 3-9-5 mixture was equivalent to 190 pounds of the dolomite per ton, and that of the fertilizer materials in the high-analysis mixture to double this amount. The amount of dolomite actually used in this study varied from 95 to 380 pounds per ton. Separate portions of each mixture were stored at temperatures of 30°, 45°, and 60° C. (86°, 113°, and 140° F.) and these portions were sampled at regular intervals.

#### Reaction of Dolomite with Superphosphate

A study was made of the factors affecting the reactions of dolomite in dolomite-superphosphate mixtures, preliminary to the work with complete fertilizer mixture.

In mixtures of 1 part of 200-mesh dolomite and 2 parts of superphosphate about 9 per cent of the magnesia became water-soluble after 7 days of storage at 30°C. This decreased to 6.5 per cent as the time of storage was lengthened to 120 days. The citrate-soluble magnesia, however, increased with storage. The maximum citrate solubility of the magnesia in a given quantity of dolomite was about 35 per cent greater after 120 days at 30°C. when 2 parts of superphosphate were present than when it was absent.

The water and citrate solubility of the magnesia in mixtures of super-phosphate with varying quantities of dolomite stored for 120 days at 30°C. show that the increase in citrate solubility of the magnesia decreases with increase in the proportion of dolomite in the mixture. Thus, from a citrate solubility of nearly 58 per cent of the total magnesia in mixtures of 15 pounds of dolomite per 100 pounds of superphosphate there is a decrease in mixtures containing equal parts of dolomite and superphosphate to about that found for dolomite alone.

#### Decomposition of 30-Mesh Dolomite in Complete Mixtures

The curves in Figure 3 (attached) represent the decomposition at different temperatures of dolomite in the complete fertilizer mixtures studied. The total decomposition and the rate of reaction were the greatest at 60°C., and more decomposition was found in the ammoniated than in the nonammoniated mixtures.

In the low-analysis mixtures 190 pounds of dolomite represent the amount required to make a physiologically neutral mixture; 380 pounds were required for the 6-18-10 mixtures. In the nonammoniated 6-18-10 mixture, less than 10 per cent of the dolomite required to make a physiologically neutral mixture was decomposed at 30°C. in 90 days; in the 3-9-5 ammoniated mixture, about 50 per cent of the dolomite was decomposed.

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### Water-Soluble Magnesia in Fertilizer Mixtures Containing Dolomite

The acid component of a superphosphate that has been ammoniated as in ordinary commercial practice is mono-ammonium phosphate. The reaction of dolomite with this component of an ammoniated superphosphate is therefore different from that which occurs with the mono-calcium phosphate of an ordinary superphosphate.

Although the magnesium compound formed by reaction of dolomite in an ammoniated superphosphate mixture is thus different from that formed in an ordinary superphosphate mixture, both products have the common property of being only slightly soluble but readily citrate soluble.

Results indicate that the water-soluble magnesia in the mixtures reaches a maximum after standing for a time, after which it may actually decrease. The highest amounts found (Figure 5, attached) were about 0.4 per cent in the 6-18-10 nonammoniated mixtures maintained at 45°C. for 7 days and in the one maintained at 30°C. for 30 to 60 days.

The curves in Figure 3 (attached) show that at the expiration of 90 days the extent of the decomposition of the dolomite was greater in the ammoniated than in the nonammoniated mixtures. It would be expected, therefore, that the sum of the water-soluble and citrate-soluble magnesia in the ammoniated mixtures would be greater after storage than in the nonammoniated mixtures.

In the mixtures stored at 30°C. the total soluble magnesia did not increase more than 0.1 to 0.2 per cent on standing. Slightly greater increases were noted in the mixtures stored at 45°C. but the soluble magnesia increased nearly fourfold in the ammoniated mixtures stored at 60°C. This gave a soluble magnesia content of from 1.0 to 1.2 per cent, which is about that added to the average fertilizer to correct magnesium deficiency in the soil.

The highest content of soluble magnesia was found in the ammoniated 6-18-10 mixture containing 380 pounds of dolomite per ton and stored at 60°C. for 90 days. In this physiologically neutral mixture the soluble magnesia increased from 0.62 to 2.07 per cent, which is claimed to be ample for most agricultural purposes.

### Effect of Dolomite on Water-Soluble Phosphorus in Fertilizer Mixtures

There is a regular decrease with time of storage in the water-soluble phosphoric acid in ammoniated mixtures; the rate of decrease is at a maximum during the first 30 days of storage; and also the water-soluble phosphoric acid in ammoniated mixtures decreases more rapidly than in nonammoniated mixtures. This affords further support to the conclusion that the monoammonium phosphate in ammoniated mixtures is more reactive towards dolomite than is the monocalcium phosphate in nonammoniated mixtures.

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### Effect of Dolomite on Citrate-Insoluble Phosphorus in Fertilizer Mixtures

The availability of the phosphoric acid in ammoniated mixtures remains unchanged on standing at normal temperatures but the citrate-insoluble phosphoric acid in mixtures of this kind increases with the temperature and with the time of storage when the mixtures are stored above 45°C. A change in the proportion of the dolomite has a small but noticeable effect in nonammoniated mixtures stored at 60°C. and a greater effect in ammoniated mixtures.

### Effect of Dolomite on Loss of Nitrogen

The reaction in which dolomite is involved in the ammoniated mixtures leads to the formation of ammonium sulfate rather than diammonium phosphate, and no nitrogen is lost. A constant check on the nitrogen content of the mixtures confirmed this prediction since no loss of nitrogen was found even in the mixtures maintained at the higher temperatures.

### Summary

Dolomite undergoes decomposition in ammoniated as well as in nonammoniated mixtures. Monoammonium phosphate is more reactive towards dolomite than the monocalcium phosphate of nonammoniated mixtures. The dolomite decomposed in 90 days in a physiologically neutral 3-9-5 mixture amounted to 27 per cent of the total at 30°C. and in the corresponding ammoniated mixture to 47 per cent at 30° or 73 per cent at 60°C.

The water-soluble magnesia in mixtures that contain dolomite as the only source of this constituent is low in both types of mixtures. The citrate-soluble magnesia in stored ammoniated mixtures is greater than in nonammoniated mixtures and increases with increase in the temperature of the mixture. A maximum soluble magnesia content of 2.07 per cent was found in a physiologically neutral 6-18-10 mixture stored at 60°C. for 90 days.

The water-soluble phosphoric acid decreases more rapidly in ammoniated than in nonammoniated mixtures. Little or no change occurs in the citrate-insoluble phosphoric acid in either type of mixture at ordinary temperatures, but a significant increase in citrate-insoluble phosphoric acid occurred in ammoniated mixtures stored at 60°C. for 90 days and to a smaller extent in nonammoniated mixtures.

No loss of ammonia occurred in any of the treatments to which the mixtures were subjected.

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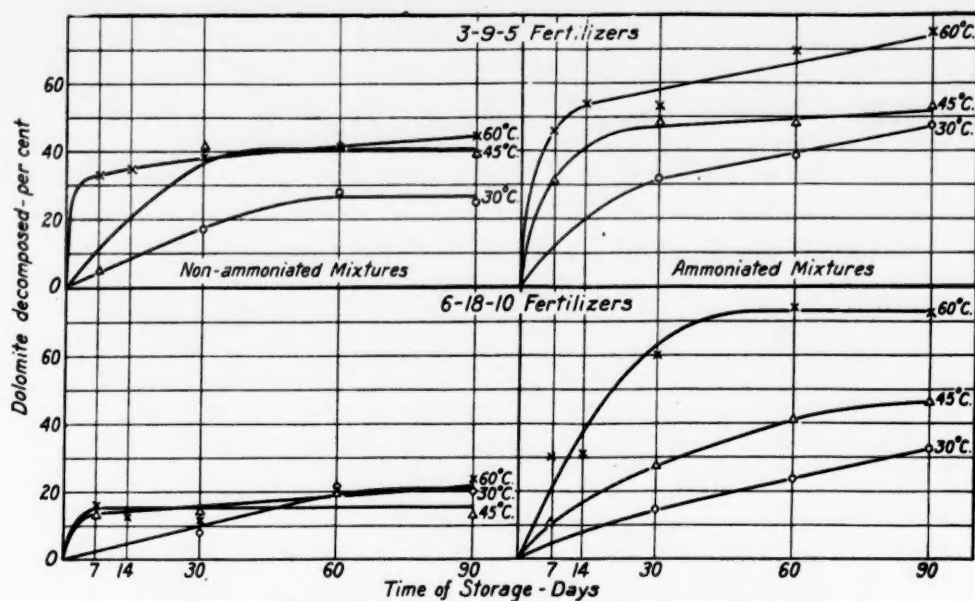


FIGURE 3. EFFECT OF STORAGE ON DOLOMITE DECOMPOSITION IN FERTILIZER MIXTURES CONTAINING 190 POUNDS OF <30-MESH DOLOMITE PER TON

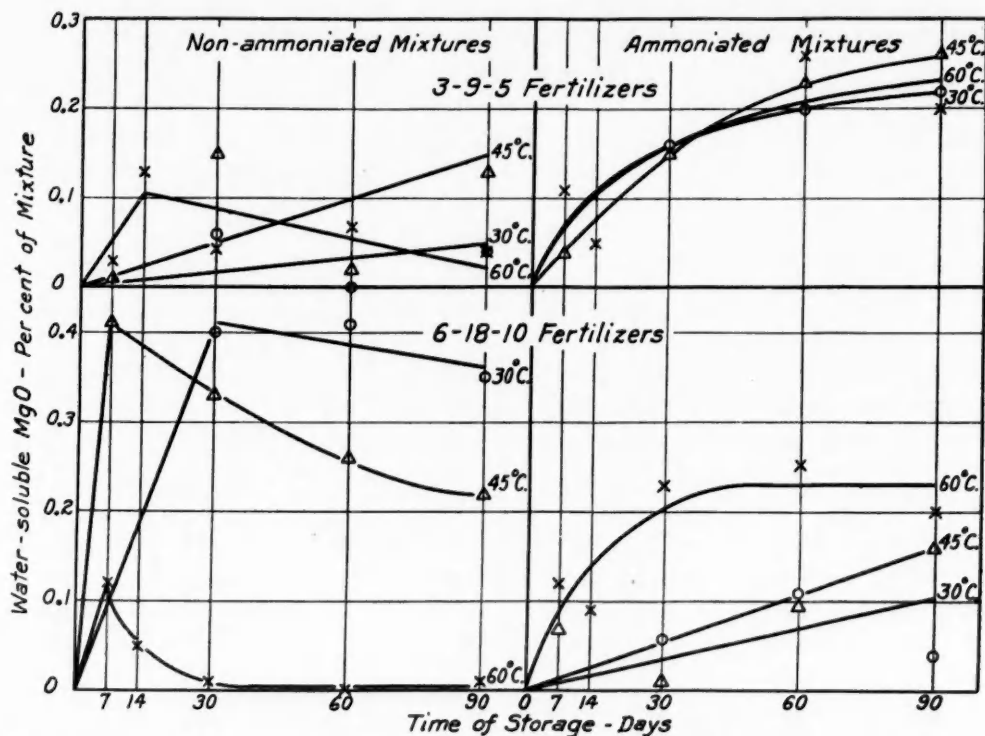


FIGURE 5. EFFECT OF STORAGE ON WATER-SOLUBLE MAGNESIA IN FERTILIZER MIXTURES CONTAINING 190 POUNDS OF <30-MESH DOLOMITE PER TON

RESEARCH UNDER WAY TO DEVELOP MEANS TO EXTEND CONTROL  
OF FUNGI AND BACTERIA RESPONSIBLE FOR PLANT DISEASES

EDITOR'S NOTE:- Some of the problems confronting the investigator concerned with the development of fungicides and bactericides for the prevention of plant diseases are discussed in this article.

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The announcement by the Bayer-Semesan Company, Inc.\*- that a new laboratory has been established at Minquadales, Delaware, directs attention to man's constant struggle to protect crops against the underworld criminals of the plant kingdom, the fungi and bacteria that are responsible for most plant diseases. It also suggests that numerous products of organic chemistry are being marshaled against the foes of American agriculture.

The new facilities for research in the field of plant disease control denote the expansion of a program begun by the parent companies several years ago and continued by the Bayer-Semesan Company since its organization in 1928. The scope of the investigations to be undertaken will be limited, as heretofore, to the development of germicides, fungicides and disinfectants for use on seeds, soils and living plant parts such as foliage and fruit.

Products developed and sold under the Bayer-Semesan's "Du Bay" trade-mark cover a wide range of fungicidal uses on a variety of farm crops. Among the most important are the organic mercury preparations trade-marked New Improved "Ceresan," a dust disinfectant for the control of certain grain smuts; New Improved "Semesan Jr.," for the treatment of seed corn; New Improved "Semesan Bel," providing a quick dip method for treating white and sweet potatoes; 2% "Ceresan," for the disinfection of cotton, flax and certain other crop seeds; and "Semesan," the original organic mercurial of the line, used as a treatment for vegetables and flower seeds and also for the control of brown patch on golf greens.

Discovering Causes of Diseases

Not so many years ago measures for the control of plant diseases were based largely on observations and methods little better than superstitions. As a matter of fact, many people today misinterpret the relation of weather conditions to plant diseases. For example, they think of wet weather as the direct

\*Affiliate of the du Pont Company and the Winthrop Chemical Company.

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cause rather than usually a mere factor contributing to the outbreaks of such diseases as late blight of potato, apple scab, and others.

Modern methods for utilizing chemicals to control plant diseases do not overlook such important influences as weather and climate, but they do recognize also the need for discovering the exact cause of an ailment. In the case of plant diseases caused by fungi and bacteria, this means learning the identity of the causal organism and the details of its private life. The plant pathologist determines how the parasite reproduces, and where and in what form it spends its time when not actually engaged in its parasitic activities. He studies, too, its preferences and prejudices as to temperature, moisture and other environmental conditions, and he is constantly alert to discover any weak point in the life cycle of the organism, because it is at that point control measures must be directed.

For example, the fungus responsible for the stinking smut or bunt disease of wheat spends the active portion of its life within the tissues of the growing wheat plant, where it keeps pace with the growth of its host and finally reaches maturity in the form of smut balls, which replace the normal kernels of wheat. This strategic location of the parasite within the wheat plant makes it virtually impossible to destroy the fungus without at the same time killing its victimized host. So the scientist seeks a more opportune moment for launching his attack. He finds it during the period when the wheat plant and its fungous enemy are in their dormant stages, the former as a seed and the latter in the form of seed-like microscopic bodies called spores. During the grain-threshing operation the smut balls have been broken up, and the millions of spores of which they are composed have been distributed over the kernels of otherwise disease-free wheat.

That is the situation for which the investigator has been watching. These spores constitute the only means by which this fungus can live over winter and attack the succeeding crop of wheat. They are in an exposed position on the outside of the seed, where they can be destroyed by any one of a number of chemicals without injury to the dormant seed. A mere pinch of ethyl mercury phosphate, suitably diluted with a carrier to facilitate its distribution over the seed, is sufficient to destroy all the millions of spores in a bushel of smutty seed wheat. Freed of its smut parasite by the powerful disinfecting action of the chemical, the seed, which is not harmed, is able to produce a healthy crop of wheat during the following year.

Fungi and bacteria foolish enough to spend their moments of leisure in an exposed position on the surface of the seed make the problem of the plant pathologist relatively easy of solution. Some plant disease organisms are much more crafty. For example, the fungus causing loose smut of wheat, a distant cousin of the stinking smut organism, chooses to hibernate inside the seed, where it is unaffected by surface applications of chemicals. Such a situation complicates the task of working out suitable control measures. In such cases the plant pathologist falls back on his knowledge of the likes and dislikes of the fungus. He has learned that wheat seed can tolerate higher temperatures than can the fungus within its tissues, so he immerses the seed in a bath of water hot enough to be lethal to the parasite but relatively harmless to the seed.

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### Study of Soil-borne Diseases

In addition to seed-borne diseases, another group will engage the attention of investigators at Minquadale- the class known as soil-borne diseases. They are caused by parasitic organisms - usually fungi and bacteria - that infest the soil and are ever ready to attack the germinating seed, the struggling young seedling, or even mature plants. The list of these soil-borne diseases is increasing in length and in economic importance as they find their way to new fields of malicious endeavor. This group includes Rhizoctonia and common scab of white potato, stem rot of sweet potato, root rot of cotton, basal rot of narcissus, onion smut, bottom rot of lettuce, Southern blight of truck crops, damping-off of seedlings and other diseases.

If we remember that an infested soil contains countless millions of these organisms and that in some cases they may penetrate to a depth of as much as fifteen feet, we shall have some inkling of the difficulties involved in protecting plants against their attacks.

These parasites carry on their deadly work under a wide variety of conditions. A window-box gardener in a New York flat wonders why her tiny flower seedlings, so carefully tended, have died overnight from damping-off; a potato grower in New Jersey grumbles as he takes a heavy loss on his year's work because scab has produced its unsightly blemish on his tubers and left them unmarketable; and the cotton grower in Texas notes with alarm the underground progress of the cotton root-rot fungus by observing the effects upon his plants.

For some of these soil-borne diseases commercially satisfactory control measures have already been worked out, but suitable remedies for many others are not yet available. In developing chemicals for this purpose the difficulty lies not so much in locating effective disinfectants as in finding efficient products which are inexpensive enough for use on large areas of soil. The problem is complicated also by the probable effect of the chemical on the beneficial organisms in the soil. With few fungicides specific in their action, there is always the potential danger of destroying the friendly as well as the hostile organisms.

The third group of diseases to be investigated by the new research unit are those which attack foliage and fruit, such as late blight of potato and scab of apple. Commercial crop growers know them well, although the home gardener may be more familiar with mildew of lima beans, black spot of roses, or rust of hollyhocks.

Since infection usually takes place first on the foliage, the plant pathologist, with the aid of the chemist, has devised various combinations of chemicals to be applied as protective films to the surfaces of the leaves. So far, the sulfur and the copper compounds have proved most useful for this purpose. Applied in diluted form as sprays or dusts, these fungicides prevent infections by fungous spores or bacteria carried to the leaves or fruit by the wind, rain and other means.

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Here again the research worker's problem is hedged about with numerous restrictions. For example, the fungicide sought must be highly toxic to the parasite to be controlled, but it must not be injurious to the delicate foliage. Moreover, a fungicide suitable for application to fruit or other edible portions of a plant must be harmless to those who may consume it with the food product.

Unquestionably, the most difficult phase of the problems to be undertaken by the laboratory staff will not be the search for chemicals high in fungicidal efficiency, but in adapting them to practical use on seeds, soils and living plants. It should not be assumed that chemicals are man's only effective weapon against those fungi and bacteria which maintain a continuous threat against his food supply. Plant quarantines, crop sanitation, crop rotation, and particularly the success of the plant breeder in originating strains of plants resistant to disease are other means of checking the destructiveness of these underworld characters of the plant kingdom.

The extent, however, to which the plant pathologist now relies on the products of the chemical laboratory forecasts a continuation of the successful use of fungicides to control plant diseases. Those who have watched the development of new and better fungicides have faith in organic chemistry as the means of solving many problems in this field. To that end the staff of the new laboratory continues its work on a larger scale.

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NEW REGIONAL LABORATORIES AID U. S. RESEARCH  
IN AGRICULTURE ALONG SEVERAL IMPORTANT LINES

EDITOR'S NOTE:- A distinct and valuable contribution to agriculture has been made by the United States Department of Agriculture in the establishing of regional laboratories to achieve through research and experiment the solutions of problems of real importance. These activities are certain to be of great benefit to agriculture as a whole.

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Three new regional laboratories for investigation of regional problems of agriculture are outstanding developments in the program of scientific research in which the States are cooperating with the United States Department of Agriculture according to Dr. James T. Jardine, Chief of the Office of Experiment Stations, in his report to the Secretary of Agriculture. A laboratory for study of animal parasites in the Southeast, one for development of swine breeding in the North Central States, and a third laboratory for sheep improvement in the range States, were approved under provisions of the Bankhead-Jones Act.

The three new laboratories supplement three similar developments - the vegetable breeding laboratory for the Southeast, the soybean laboratory in the Corn Belt, and the pasture improvement laboratory for the Northeast--which are now well established with research going forward. Doctor Jardine says that this development of research according to regional needs "has had the whole-hearted active interest and help of the State stations."

Regional research has been made possible by appropriations under the Bankhead-Jones Act, which--unlike previous legislation for support of the experiment stations--requires State appropriations to offset the Federal contributions. Each State complied with this requirement and on the average State appropriations were several times requirements under this provision. Total funds from State sources not only met the new offset requirements but amounted to about \$12,000,000, or slightly more than \$2 from State sources for each \$1 from all Federal grants for support of the experiment stations and approximately six times the Federal grant offset requirement. Under the Hatch, Adams, and Purnell Acts each State continued to receive equal appropriations. The Bankhead-Jones Act allots funds on the basis of the rural population of each State.

Studies Along Four Important Lines

The laboratory for the study of diseases and parasites of domestic animals is being established at the Alabama Polytechnic Institute at Auburn. The experiment stations of 13 southeastern States are cooperating with the Department in

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the development of the program for the regional studies which will be under way in all the States with headquarters and coordinating direction at Auburn. The States are, Virginia, North Carolina, South Carolina, Georgia, Florida, Alabama, Mississippi, Louisiana, Texas, Arkansas, Tennessee, Kentucky and Oklahoma.

Headquarters for the laboratory devoted to the improvement of swine through breeding methods is to be at the Iowa experiment station at Ames. Thirteen States in the region outlined the program and Iowa, Minnesota, Nebraska, and Missouri have agreed to participate actively. It is expected that the other nine States--Illinois, Indiana, Michigan, Kansas, North Dakota, Ohio, Oklahoma, South Dakota and Wisconsin--and possibly other States, will arrange for active cooperation.

For the improvement of sheep on western ranges, 12 range States--Arizona, California, Colorado, Idaho, Montana, Nevada, New Mexico, Oregon, Texas, Utah, Washington and Wyoming--are cooperating in the program which will center at Dubois, Idaho, where the Department has suitable range available from its previous work with sheep improvement. Texas is interested in sheep breeding and for this program is included as one of the range States. Plans and specifications for the laboratory required by the enlarged program of research were approved before the end of the fiscal year and the work is now going forward.

The Office of Experiment Stations continued to represent the Department in administering and auditing Federal contributions to the experiment stations. The Office also supervises the insular stations in Hawaii and Puerto Rico. Territorial and Federal work is being merged in Hawaii and after the current fiscal year the relationships of the territorial station to the Department will be virtually on a par with those of the State stations.

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REPAIR OF LAND DRAINS MAKING GOOD FARMS BETTER  
THE BUREAU OF AGRICULTURAL ENGINEERING REPORTS

EDITOR'S NOTE:- The information given here by the United States Bureau of Agricultural Engineering serves both to show the great importance of farm drainage and to emphasize the need for maintaining drainage systems. This is supplemented by facts on special uses of dynamite in connection with ditches.

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Land drainage is coming out of a depression, according to the Bureau of Agricultural Engineering. There had been very little activity in drainage work for years and drainage systems on many farms and in many drainage districts had fallen into disrepair. Now more drain tile is going into the ground than for a long time, say the engineers and tile manufacturers.

The present stimulus for better maintenance, the Bureau says, has come in part as a result of the work done in public drainage districts with C. C. C. men in more than 40 drainage camps.

There is no effort to bring new land under cultivation, says the Bureau, but much work is now directed toward maintaining good public "low ways" to carry excess water away from farms in drainage districts much as public "high ways" are kept up as an outlet for the products of the farm.

Some of the best farms in the country are farms that were "made" through drainage. According to a classification by the National Resources Committee, about 312,000,000 acres of farm land in the United States is "excellent" or "good." About one-fourth of this high-class acreage is drained land. One of the most feasible ways to make many of these farms more efficient, says S. H. McCrory, Chief of the Bureau of Agricultural Engineering, is for the owners to keep their drainage equipment in a good state of repair.

Blasting Stumps On Drainage Ditch Banks

According to L. F. Livingston, manager of the Agricultural Extension Section of the du Pont Company, agricultural engineers in close touch with the activities of units of the C. C. C. engaged on drainage projects, state that approximately as much dynamite is used for the removal of tree stumps from the banks of drainage ditches as is required for cleaning out ditches which have become clogged. This blasting of stumps is done either for their removal when projecting roots divert the flow of water and cause scouring of the opposite bank or when it is necessary to widen a ditch to increase its capacity.

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"For blasting in either of such cases, the method differs in certain important respects from blasting stumps which are entirely surrounded by earth, as in a field," Mr. Livingston points out. "The reason for this is because of the well-known fact that the force of an explosion follows the line of least resistance, and because the least resistance is offered by the roots exposed on the ditch side.

"Here, as in all stump shooting, each stump should be examined carefully, in order that proper loading may be done. The blaster must follow certain details of the practices for blasting tap-root or spreading roots, dead or green stumps, etc. The condition of the soil, whether wet or dry, must be taken into consideration, and also the type of soil. And, of course, the size of the stump must be considered.

#### How the Loading Should be Done

"The important exception to the usual stump blasting procedures is in the placing of the dynamite. For a stump with spreading or lateral roots, the holes should be put down in the usual way at the back of the stump and at the sides. However, the side loading should be fairly well back of the center of the stump so that there will be enough of the earth of the ditch bank to confine the rapidly expanding gases of the explosion to permit as much as possible of the force to be exerted on the stump to break it up and 'kick' the pieces to either side or into the ditch. Proper loading should break a stump into pieces easy to handle.

"A stump with a large tap root can be sheared off by loading dynamite into a hole, bored in the stump with a wood auger, at an angle and slightly beyond the center of the diameter of the root. For a large tap-rooted stump with heavy lateral roots, it may be necessary to put charges under the heavier roots.

"All holes must be firmly tamped with earth. This applies whether the holes are in the ground or a hole is made in a tap root.

"Where more than one charge of dynamite is to be shot at a time, the priming must be done with electric blasting caps, the holes wired in series, and an electric blasting machine used.

"Mostly, the stumps along ditch banks are those of trees which have grown there after the ditching was done," Mr. Livingston says.

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